

Appl. No. 10/751,491  
Amdt dated Sep. 23, 2009  
Reply to Office action of Jun. 23, 2009

**Amendments to the Claims:**

1. (Currently amended) An inexpensive, programmable, frequency independent, amplitude and phase shifting circuit comprising:

an enclosure comprising:

means for holding printed circuit boards; and

a front panel for receiving input and output signals;

a motherboard comprising:

means for supplying input signals through said front panel;

a power source;

digital control lines; and

a demultiplexer circuit board;

said demultiplexer circuit board within said motherboard comprising:

a demultiplexer;

a plurality of signal receiving digital control lines coupled to the demultiplexer from a digital output card in a personal computer;

a plurality of signal sending digital control lines coupled to the demultiplexer routed to an amplitude/phase shifting circuit board; and

means for selecting a single amplifier for operator selected amplitude or phase gain change over a single frequency or sweep in frequency;

an amplitude/phase shifting circuit board comprising:

a plurality of programmable gain operational amplifiers each including a plurality of data input lines and a select line, independent of the data input lines, one amplifier selected at a time through the select line, to have its gain/and or phase changed when an operator desires a new amplitude and/or phase, each of the programmable gain operational amplifiers further including a first input signal line to receive a sine signal waveform and a second input signal line to receive a cosine signal waveform wherein each of the sine and cosine signal waveforms are of the same frequency;  
and

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a plurality of summing operational amplifiers, coupled to the plurality of programmable operational amplifiers, to sum the sine signal waveform and cosine signal waveform;

~~a plurality of signal-receiving digital control lines for receiving output lines from said demultiplexer, each of said digital control lines connected to a different multiplying operational amplifier chip select line on said amplitude/phase shifting circuit board; and~~

a plurality of output signal lines, coupled to the plurality of summing gain operational amplifiers, each output signal line to transmit a phase and/or amplitude shifted sinusoidal signal waveform having the same frequency as the the summed sine signal waveform and cosine signal waveform; and

means for controlling said amplitude/phase shifting circuit.

2. (Canceled)

3. (Original) The amplitude and phase shifting circuit of claim 1 wherein said enclosure mounts onto a standard electronics rack.

4. (Canceled)

5. (Original) The amplitude and phase shifting circuit of claim 1 wherein said means for controlling said amplitude/phase shifting circuit comprises a digital output card from a personal computer.

6. (Original) The amplitude and phase shifting circuit of claim 5 wherein said digital output card interfaces with said amplitude/phase shifting circuit through a 50 pin ribbon cable.

7. (Original) The amplitude and phase shifting circuit of claim 5 wherein an operator interfaces with said digital output card through software.

8. (Canceled)

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9. (Currently amended) An inexpensive, programmable, frequency independent, multiple channel amplitude and phase shifting method comprising the steps of:

inputting sine and cosine signal waveforms, each having the same frequency, to two programmable gain operational amplifiers on an amplitude/phase shifting circuit board, each of the two programmable gain operation amplifiers having an output;

summing said outputs of said two programmable gain operational amplifiers using one summing operational amplifier on said amplitude/phase shifting circuit board to generate an amplitude and/or phase shifted sinusoidal signal waveform having the same frequency as the sine and cosine signal waveforms;

implementing four channels of said inputting and summing steps on said amplitude/phase shifting circuit board, each of said channels connected to a demultiplexer circuit board;

powering said demultiplexer circuit board and said amplitude/phase shifting circuit boards through a motherboard;

selecting one of said four channels for a gain and/or phase change through said demultiplexer circuit board over a single frequency or sweep in frequency;

controlling said programmable, multiple channel amplitude and phase shifting circuit;

sending ~~said~~ said an amplitude and phase shifted sinusoidal signal waveform having the same frequency as the sine and cosine signal waveforms to an output line interfacing with a panel on an enclosure containing said motherboard, said demultiplexer circuit board and said amplitude/phase shifting circuit board.

10. (Canceled)

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11. (Previously presented) The inexpensive, programmable, frequency independent, multiple channel amplitude and phase shifting method of claim 9 wherein said controlling step further comprises controlling said programmable, multiple channel amplitude and phase shifting circuit using a digital output card from a personal computer.

12. (Previously presented) The inexpensive, programmable, frequency independent, multiple channel amplitude and phase shifting method of claim 11 wherein said controlling step further comprises

controlling said programmable, multiple channel amplitude and phase shifting circuit using a digital output card from a personal computer; and  
operator interfacing with said digital output card with software.

13-14. (Canceled)

15. (Previously presented) The inexpensive, programmable, frequency independent, multiple channel amplitude and phase shifting method of claim 9 wherein said selecting step further comprises the steps of:

determining timing and sequence of reading data lines from said motherboard;

storing data in a buffer; and

changing gain of a selected operational amplifier over a single frequency or sweep in frequency.

16. (Previously presented) The inexpensive, programmable, frequency independent, multiple channel amplitude and phase shifting method of claim 9 wherein said inputting step further comprises inputting sine and cosine signal waveforms to two programmable gain operational amplifiers on an amplitude/phase shifting circuit board through a motherboard.

17. (New) A programmable, frequency independent, amplitude and phase shifting signal generating device comprising:

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a plurality of amplitude/phase shifting circuits, wherein each of said amplitude/ phase shifting circuits comprises:

a plurality of programmable gain operational amplifiers, each programmable gain operational amplifier including a select line and a plurality of data lines, the select line being independent of the data lines, the select line to receive a signal to enable a selected one of the plurality of programmable operational amplifiers to recognize data received on the plurality of data lines, each of the programmable gain operational amplifiers further including a first input signal line to receive a sine signal waveform and a second input signal line to receive a cosine signal waveform wherein each of the sine and cosine signal waveforms are of the same frequency, and a first output signal line and a second output signal line;

a plurality of summing operational amplifiers each coupled to one of the plurality of programmable operational amplifiers and to the first and second output signal lines of the programmable operational amplifiers, to sum the outputs on the first and second output signal lines to generate an amplitude and/or phase shifted sinusoidal signal waveform having the same frequency as the sine and cosine signal waveforms; and

a demultiplexer circuit comprising:

a demultiplexer;

a plurality of signal receiving digital control lines coupled to the demultiplexer to receive control signals from a controller;

a plurality of signal sending digital control lines coupled to the demultiplexer and coupled to the plurality of amplitude/phase shifting circuits; and

a plurality of control lines coupled to the demultiplexer, one of the plurality of control lines being coupled to one the the plurality of amplitude/phase shifting circuit boards, to select one of the plurality of amplitude/phase shifting circuit boards to provide an amplitude and/or phase shifted sinusoidal signal waveform having the same frequency as the sine and cosine signal waveforms.

18. (New) A programmable, frequency independent, multiple channel amplitude and phase shifting signal generation method comprising the steps of:

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generating a control signal over a select line and data signals over a plurality of data lines of a demultiplexer;

receiving the control signal and the data signals at an amplitude/phase shifting circuit board have a plurality of channels, each of the channels being selected for operation by the control signal;

inputting sine and cosine signal waveforms, each having the same frequency, to two programmable gain operational amplifiers on the amplitude/phase shifting circuit board, the two programmable gain operational amplifiers being selected by the control signal, each of the two programmable gain operation amplifiers having an output;

summing the outputs of the two programmable gain operational amplifiers using a summing operational amplifier on the amplitude/phase shifting circuit board to generate an amplitude and/or phase shifted sinusoidal signal waveform having the same frequency as the sine and cosine signal waveforms;

sending the amplitude and phase shifted sinusoidal signal waveform having the same frequency as the sine and cosine signal waveforms to an output connector for use; and

selecting another of one of the plurality of channels to generate another amplitude and/or phase shifted sinusoidal signal waveform.

19. (New) The programmable, frequency independent, multiple channel amplitude and phase shifting signal generation method of claim 18, wherein the generating step further comprises generating a new group of data signals during selection of another of the plurality of channels to thereby generate a new phase and/or amplitude shifted sinusoidal waveform signal different than the one previously generated.

20. (New) The programmable, frequency independent, multiple channel amplitude and phase shifting signal generation method of claim 19, wherein the new phase and/or amplitude shifted sinusoidal waveform signal and the previously generated phase and/or amplitude shifted sinusoidal waveform signal have the same frequency but different phases and/or amplitudes.